RESEARCH HIGHLIGHTS

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INFLUENCE OF AN ELECTRONIC AIR CLEANER ON INDOOR OZONE

Introduction

Plate and wire type Electronic Air Cleaners (EAC) are frequently found in the central forced air systems of Canadian houses. They are often sold on the basis of their potential to relieve the symptoms of persons who suffer from allergy-related and respiratory conditions. This beneficial effect is based on the rationale that a reduction in indoor airborne particulate level will alleviate the conditions of those who have respiratory challenges.

Although EACs are excellent filters[1], especially in the fine particle range, it is known that they produce ozone during operation, and ozone is a known respiratory irritant. Current public health practice is to declare "bad air days" when outdoor ozone levels are expected to exceed 82 ppb for one hour. Persons with respiratory challenges are advised to remain indoors and to keep windows and doors closed. The exposure of persons who remained indoors is considered to be primarily a function of the outdoor ozone level and the sheltering effect of the building.

Until recently, it has been accepted that EACs did not significantly decrease indoor air quality due to their relatively small ozone production rates, however recent studies have found that:

a) Winter indoor ozone levels tend to be higher in homes which are equipped with an EAC than in homes which do not have an EAC.

b) Production of ozone from EAC's does not appear to be related to maintenance, or condition, rather it appears to be relatively constant[2], provided that the EAC is functioning.

c) The effects of ozone on population health are seen at much lower ambient concentrations.

d) Some house dust mite allergic-asthmatic persons are more sensitive to ozone than non-asthmatic, non-allergic persons.

The combination of these recent findings lead to the possibility that EAC devices may contribute to raising indoor ozone levels and may cause subsequent negative health impacts.

The purpose of the project was to determine the degree to which ozone levels in a home are influenced by the operation of an EAC and whether or not the ozone levels are affected by changes in house ventilation rate and changes in airflow through the EAC.

Research Program

All of the experiments are based on one air-handler and EAC arrangement in one home in Brantford, Ontario, Canada during November and December 2000. A total of 185 hours of data were obtained under varying conditions of house ventilation, EAC airflow and EAC operation. The air-handling system was operated continuously and all the windows were kept closed.

[1] CMHC Research Highlight 99-108, *The Effects of Improved Residential Filtration on Particle Exposure*

[2] *Evaluation of Residential Furnace Filters*, CMHC Research Report, 1999, Cat #NH15-318/1999

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Test Measurements

Samples were obtained using a real-time data acquisition system with a UV Photometric ozone monitor sampling from outside, upstream of the EAC, office area (basement), downstream of the EAC and bedroom (upstairs). Continuous weather data was used to predict air-exchange rates. The air-change model was validated by CO_2 tracer-gas testing. Data was analyzed using a model which accounted for air-change, internal removal, source strength and filtration of incoming air. Using house characteristic and source-strength values obtained from the experiments, inside ozone levels were predicted for a variety of air-change rates and outdoor ozone levels.

Real-time multi-location data acquisition was necessary due to the dynamic nature of indoor ozone levels which are influenced by:

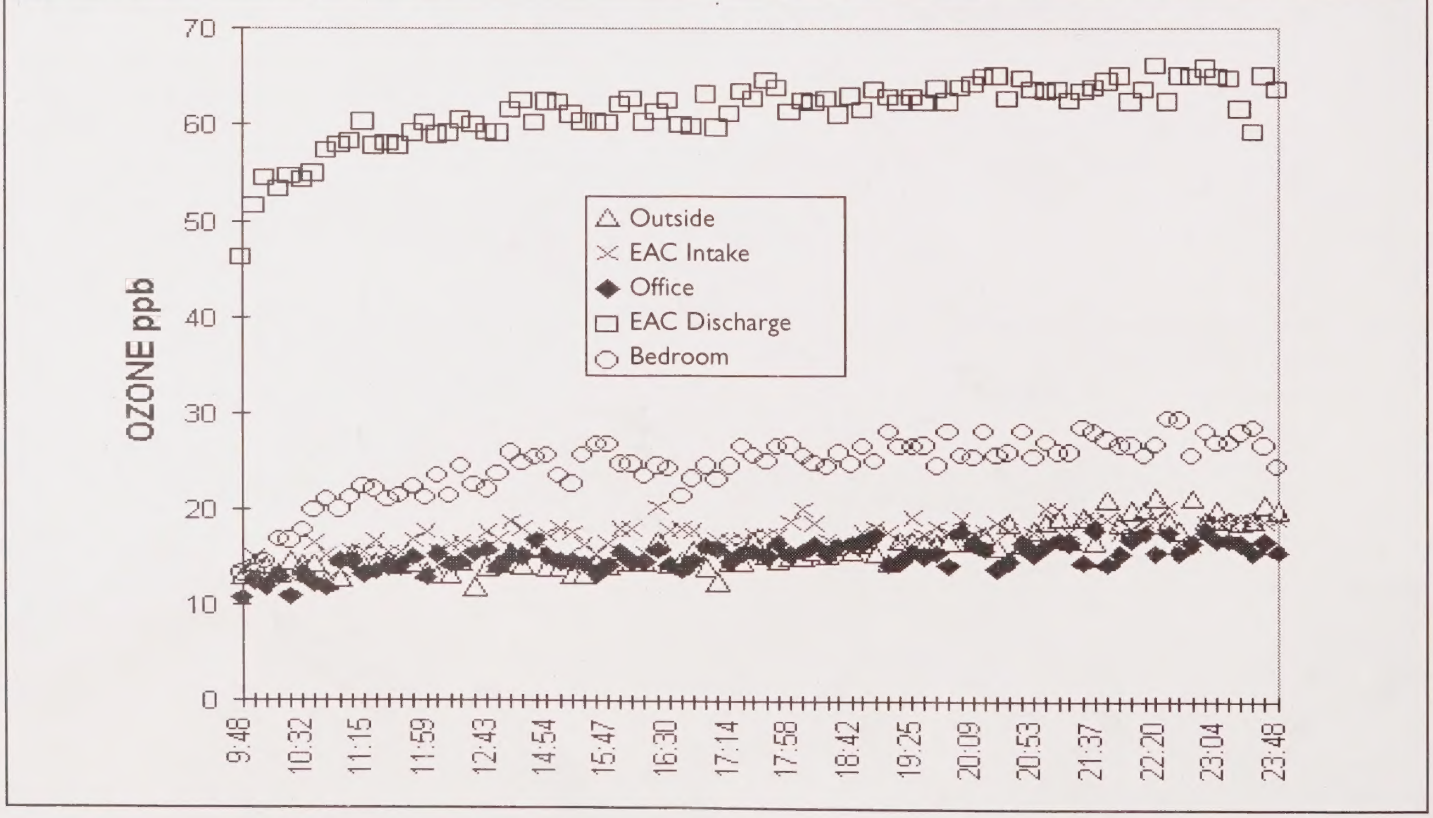
- outdoor ozone level
- air change rate
- rate at which ozone is removed from infiltrating air by the building envelope
- rate at which ozone is removed from indoor air (soft surfaces remove more ozone)
- internal generation rate of devices such as EAC's

Experiments were carried out under the following conditions:

- EAC on vs EAC off
- Air Handler High (340 L/s) [720 cfm] vs Air Handler Low (166 L/s), [352 cfm]
- Ventilation Low (Natural only) vs Ventilation High (Added Exhaust 47 L/s)

A typical set of experimental results is shown in Figure 1.

Figure 1: Experiment #7b, EAC On, Airflow Low, Ventilation Low



Findings

Although outdoor ozone remains the most significant determinant of indoor ozone, it was concluded that the continuous operation of an EAC could result in a rise of inside ozone concentration by 7 to 10 ppb higher than that which would normally be expected without EAC operation. Ozone concentration increase can be expected to be higher than this for smaller homes and homes with smoother surfaces (for example, smooth floors vs carpeting). Conversely, the increase will be lower for larger homes with less smooth surfaces. Predicted ozone levels for the subject house at varying outdoor ozone levels are shown in Figure 2.

Changes in airflow through the EAC had a minor effect on ozone levels. Reducing the airflow by 50 per cent resulted in an increase of ozone production and interior levels of less than 10 per cent.

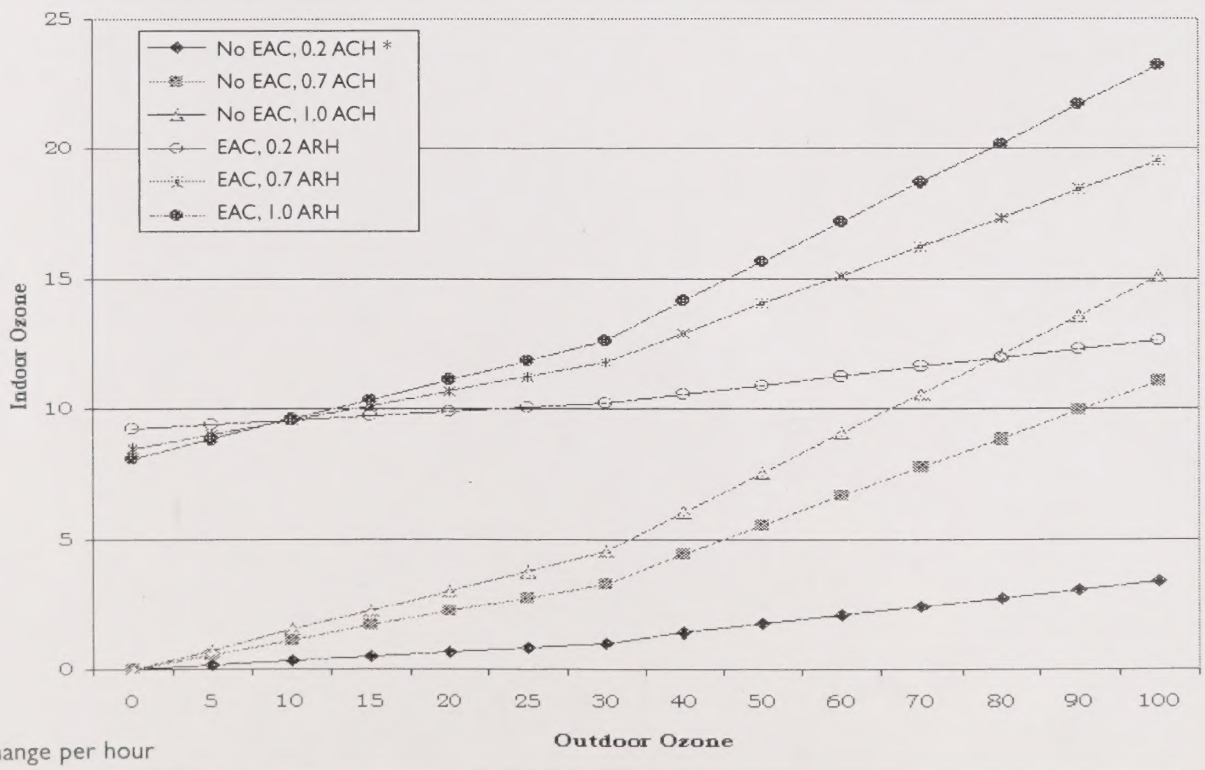
No conclusions were reached concerning the effect of ventilation and filtration by the building envelope due to the lack of difference between indoor and outdoor ozone levels experienced during the experimental period.

Implications for the Housing Industry

Winter-time indoor/outdoor ratios used for predictive studies of a population's exposure to ozone may require revision upwards from current estimates for homes equipped with continuously operating EAC's.

EAC devices appear to be capable of elevating the ozone level inside a home to levels which are continuously at or above 10 ppb. Current knowledge does not allow us to state that the health of susceptible individuals will not be affected. Persons purchasing or currently employing EAC units to improve their respiratory health should be aware of this effect.

Figure 2: Predicted Indoor Ozone Levels



* air change per hour

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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